

TITLE OF INVENTION
CLOSED LOOP HEAT THERAPY BLANKET

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation of, and claims the benefit of,
5 International Application No. PCT/US03/36075, filed November 13, 2003.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR
DEVELOPMENT

[0002] Not Applicable

BACKGROUND OF THE INVENTION

10 1. Field of Invention

[0003] This invention pertains to convective heat therapy blankets.
More specifically, the present invention relates to a heat therapy blanket
wherein heated air not directed to the patient is recirculated through the
blanket to recapture heat, thereby reducing heat emitted into the
15 surrounding environment and reducing the required capacity of the
associated heater.

2. Description of the Related Art

[0004] In the field of patient warming, it is well known that
hypothermia is of concern. Hypothermia has been defined as a condition of
20 subnormal body temperature which presents serious consequences to the
patient. It has been shown that a large percentage of surgical patients
develop hypothermia. The hypothermic condition is brought on by many
factors including anesthesia, the air conditioning of the operating room, and
the infusion of cold blood, I-V solutions, or irrigating fluids. Outside an
25 operating room, hypothermia can occur when an individual has had

prolonged exposure to a hostile environment such as freezing rain, snow or bitter cold.

[0005] Regardless of the cause of hypothermia, the individual initially experiences extreme discomfort which can quickly lead to a life threatening situation. It is known that one suffering from hypothermia must be attended to quickly in order to avoid irreversible body temperature drop or even death. Simply wrapping a person suffering from hypothermia in a blanket is a solution which can provide some relief, the blanket helping to retain body heat. This results in a gradual warming of the body. However, this method is not always sufficient to overcome hypothermia. The ability of the body to produce sufficient heat in sufficient time may not be possible or feasible in certain situations. Additionally, use of a blanket during or after an operation in a hospital can be cumbersome. It may be difficult to fully cover the patient's body due to intravenous tubing and other life supporting equipment which physically hinders placement of the blanket.

[0006] Another method used for heat therapy is an inflatable blanket used to direct heated air to a patient. Typically, these are used for surgical patients to maintain body temperatures while undergoing surgical or other procedures. A concern that arises in the use of such is the direct contact of heated air with an open wound or other skin conditions. This is especially of concern when the heated air is contaminated.

[0007] Various devices have been developed for heat therapy. Typical of the art are those devices disclosed in the following U.S. Patents:

Patent No.	Inventor(s)	Issue Date
2,093,834	R. S. Gaugler	Sept. 21, 1937
4,572,188	S. D. Augustine <i>et al.</i>	Feb. 25, 1986
4,660,388	G. J. Greene, Jr.	Apr. 28, 1987
4,777,802	S. Feher	Oct. 18, 1988
5,106,373	S. D. Augustine <i>et al.</i>	Apr. 21, 1992
5,184,612	S. D. Augustine	Feb. 9, 1993
5,300,102	S. D. Augustine <i>et al.</i>	Apr. 5, 1994
5,304,213	L. D. Berke <i>et al.</i>	Apr. 19, 1994
5,324,320	S. D. Augustine <i>et al.</i>	June 28, 1994

5,336,250	S. D. Augustine	Aug. 9, 1994
5,350,417	S. D. Augustine	Sept. 27, 1994
5,405,371	S. D. Augustine <i>et al.</i>	Apr. 11, 1995

5 **[0008]** Of these patents, the '834 patent issued to Gaugler discloses a refrigerating apparatus including an air blanket and a heating or cooling unit. The air blanket is fabricated from three layers of material. The lower layer is provided as a sheet to be placed over the user. Between the first and second layers is defined a plurality of air ducts through which the air
10 travels. The lower layer is air-permeable such to direct the air to the user. The upper layer is provided to limit the bulging of the second layer when air is injected through the air ducts. In one embodiment, the air blanket defines a U-shaped return duct between the second and upper layers blanket. The '834 device is also described as having an evaporator for use
15 when cooling the user and a humidifier when heating the user, the evaporator and humidifier each being provided for controlling the humidity of the air being directed toward the user.

[0009] The remaining patents disclose various air blankets for directing temperature controlled air toward a person situated under the
20 blanket. Generally, these devices include a bottom layer constructed to be air-permeable and a top layer fabricated from an air-impermeable material. The bottom layer may be fabricated from an air-impermeable material and provided with openings for the passage of air, or may be fabricated from an air-permeable material. Each blanket defines a series of baffles through
25 which the air travels before being directed through the bottom layer.

[0010] With these devices, air not directed to the person is forced into the surrounding environment in which the blanket is utilized. In an operating room, the exhaust of heated air into the room is adverse to the medical professionals who are trying to remain cool. The need to keep the
30 patient warm takes precedent over the need to keep the medical professionals cool. However, an ideal situation provides for the patient to be

warmed without substantially effecting the temperature of the immediate surroundings.

[0011] Illustrated generically in FIGS. 1 and 2 is one embodiment similar to the above devices 10P. A lower sheet 24P is dimensioned to cover the patient and drape over the sides of the bed (not shown). An air-impermeable upper sheet 12P is fixed to the lower sheet 24P. Baffles 58P are defined between the upper and lower sheets 12P,24P in a conventional manner such as by sonic welding, sewing or the like. The lower sheet 24P may be fabricated from either an air-impermeable or an air-permeable material. In the instance of an air-impermeable lower sheet, openings 28P are defined in the lower sheet 24P in order to direct air onto the patient. In the embodiment where the lower sheet 24P is air-permeable, the air is directed through the material to the patient without requiring openings 28P.

[0012] Other devices are disclosed in European Patent No. 716,746 issued to R. V. Lee on Oct. 13, 1954. One embodiment of the '746 device disclosed by Lee is an air conditioning cover for use on beds. The device includes an air blanket fabricated from upper and lower sheets quilted together at intervals to accomplish air circulation between the sheets. An opening is defined at one end of the upper sheet to receive an inlet duct. The upper and lower sheets are fabricated from an air-permeable material such that air directed through the inlet duct and between the upper and lower sheets is then directed through the upper and lower sheets.

BRIEF SUMMARY OF THE INVENTION

[0013] The present invention is a closed loop heat therapy blanket provided for warming a patient to prevent or treat hypothermia. The closed loop heat therapy blanket is provided for communicating heated air to a patient in a manner that releases minimal heated air to the surroundings, thus allowing the surroundings to remain more comfortable to others such as medical professionals tending to the patient. Heated air that is not

directed specifically at the patient is recirculated, thereby reducing the required heating capacity of an associated heat source.

[0014] The closed loop heat therapy blanket is primarily comprised of a first or upper sheet and a second or lower sheet secured to each other in a conventional manner at a plurality of securement regions. A first securement region is defined about the perimeter of the first sheet. A substantially U-shaped second securement region is positioned a selected distance inside the first securement region in order to define a return duct along each side and at a proximal end of the first sheet. At least one third securement region is defined inside the second securement region to define a return manifold at the distal end of the first sheet, a plurality of supply ducts along the length of the first sheet, and a supply manifold at the proximal end of the first sheet and inside the second securement region.

[0015] The first sheet defines a supply inlet opening into the supply manifold and to which a supply hose is releasably connectable. The first sheet further defines a return outlet opening from the return duct and to which a return hose is releasably connectable.

[0016] Heated air is introduced into the supply manifold via the supply hose. The heated air then travels through the supply ducts and toward the return manifold. From the return manifold, the heated air continues through the return duct and out through the return outlet and through the outlet hose. The air forced into the blanket is under pressure such that as it travels through each of the supply manifold, the supply ducts, the return manifold, and the return ducts, a portion of the heated air is communicated through the second sheet and onto and around the patient.

[0017] The second sheet extends in all directions from the first sheet in order to define a skirt. The skirt is provided for draping over the patient and extending at least to the surface of the bed, thus defining a discrete volume of air under the blanket and surrounding the patient that is to be heated.

The skirt thus retains a substantial portion of the heated air communicated toward the patient.

[0018] The first sheet is fabricated from an air-impermeable material in order to prevent heated air from escaping to the surrounding environment.

5 The second sheet is fabricated from an air-permeable material in order to allow heated air to be communicated to the patient. In the alternative, the second sheet is fabricated from an air-impermeable material and is provided with openings for the passage of heated.

[0019] A heat source is provided for collecting ambient air, heating it,
10 and directing it toward the patient through the second or lower sheet of blanket. The heated air is then communicated through the supply hose to the blanket. The heated air then travels through the blanket and at least a portion of the heated air is communicated out of the blanket and toward the patient. The heat source also serves to intake supplemental air to mix with
15 the preheated air coming from the return hose in order to supply the blanket with sufficient pressure to force the heated air through the second sheet and toward the patient.

[0020] A humidifier is provided for controlling the moisture in the air
20 being directed toward the patient. In order to prevent the moisture from being exhausted into the surroundings, both the first and second sheets are fabricated from materials that serve as moisture barriers.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0021] The above-mentioned features of the invention will become more
clearly understood from the following detailed description of the invention
25 read together with the drawings in which:

FIG. 1 is a perspective illustration of a prior art thermal heating blanket;

FIG. 2 is an elevation view, in section, of the prior art thermal heating blanket taken at **2-2** of FIG. 1;

FIG. 3 is a perspective illustration of a recirculating thermal heating blanket constructed in accordance with several features of the present invention;

FIG. 4 is an elevation view, in section, of the recirculating thermal heating blanket taken at **4-4** of FIG. 3;

FIG. 4A is an elevation view, in section, of an alternate embodiment of the recirculating thermal heating blanket taken at **4-4** of FIG. 3; and

FIG. 5 is a schematic illustration of the recirculating thermal blanket of FIG. 3 shown in a closed loop circuit with a heat source and, in the alternative, with a humidifier.

DETAILED DESCRIPTION OF THE INVENTION

[0022] A closed loop heat therapy blanket is provided for warming a patient to prevent or treat hypothermia. The closed loop heat therapy blanket is illustrated generally at **10** in the figures and is provided for communicating heated air to a patient in a manner that releases minimal heated air to the surroundings, thus allowing the surroundings to remain more comfortable to others such as medical professionals tending to the patient. Heated air that is not directed specifically at the patient is recirculated, thereby reducing the required heating capacity of an associated heat source **68**. Heat is directed toward the patient through the closed loop heat therapy blanket **10**, but not as heated air, thereby preventing any contaminants that may be in the heated air from reaching the patient and infecting any open wounds or exacerbating any skin conditions.

[0023] As best illustrated in FIG. 3, the closed loop heat therapy blanket **10**, or blanket **10**, is primarily comprised of a first or upper sheet **12** and a second or lower sheet **24**. The first and second sheets **12,24** are secured to each other in a conventional manner such as by sonic welding, gluing or sewing. A plurality of securement regions are defined, in which

the first and second sheets **12,24** are secured one to the other as described. In the illustrated embodiment, first, second and third securement regions **30,40** and **52** are defined.

[0024] The first securement region **30** is defined about a perimeter of the first sheet **12** and includes first and second longitudinal regions **32,34** disposed along opposing sides **14** of the first sheet **12** and first and second lateral regions **36,38** disposed at a proximal end **16** and a distal end **18** of the first sheet **12**, respectively. Each of the first and second longitudinal regions **32,34** and the first and second lateral regions **36,38** are connected in an end-to-end fashion.

[0025] The second securement region **40** includes third and fourth longitudinal regions **42,46** and a third lateral region **50**. The third and fourth longitudinal regions **42,46** are disposed between the first and second longitudinal regions **32,34** of the first securement region **30**. The third lateral region **50** is positioned in end-to-end fashion at a proximal end **44,48** of the third and fourth longitudinal regions **42,46**, respectively, such that the second securement region **40** defines a substantially U-shaped configuration. A return duct **62** is defined between the first and third longitudinal regions **32,42**, the second and fourth longitudinal regions **34,46**, and the first and third lateral regions **36,50**.

[0026] A third securement region **52** includes at least one fifth longitudinal region **54** defined between said third and fourth longitudinal regions **42,46** defined by the second securement region **40**. A supply manifold **56** is defined between the third lateral region **50** of the second securement region **40** and a proximal end **55** of each fifth longitudinal region **54**. At least one supply duct **58** is defined between successive pairs of the third, fourth and fifth longitudinal regions **42,46,54**. A return manifold **60** is defined between a distal end **45,49,57** of the third, fourth and fifth longitudinal regions **42,46,54**, respectively, and the second lateral region **38**.

[0027] The first sheet **12** defines a supply inlet **20** to which a supply hose **64** is releasably connectable. The supply inlet **20** opens into the supply manifold **56**. The first sheet **12** further defines a return outlet **22** to which a return hose **66** is releasably connectable. The return outlet **22**
5 opens into the return duct **62**.

[0028] Following the flow of heated air, the air is introduced into the supply manifold **56** via the supply hose **64**. The heated air then travels through the supply ducts **58** and toward the return manifold **60**. From the return manifold **60**, the heated air continues through the return duct **62**
10 and out through the return outlet **22** and through the return hose **66**. Because the air forced into the blanket **10** is under pressure, as it travels through each of the supply manifold **56**, the supply ducts **58**, the return manifold **60**, and the return ducts **62**, a portion of the heated air is communicated through the second sheet **24** and onto and around the
15 patient.

[0029] The second sheet **24** extends in all directions from the first sheet **12** in order to define a skirt **26**. The skirt **26** is provided for draping over the patient and extending at least to the surface of the bed, thus defining a discrete volume of air under the blanket **10** and surrounding the
20 patient that is to be heated. The skirt **26** thus retains a substantial portion of the heated air communicated toward the patient.

[0030] FIGS. 4 and 4A better illustrate that the first sheet **12** is fabricated from an air-impermeable material in order to prevent heated air from escaping to the surrounding environment. It will be understood by
25 those skilled in the art that various conventional materials provide air-impermeability sufficient for the purposes of the present invention. In the embodiment illustrated in FIG. 4, the second sheet **24** is fabricated from an air-permeable material in order to allow heated air to be communicated to the patient. In the alternative illustrated in FIG. 4A, the second sheet **24A**

is fabricated from an air-impermeable material and is provided with openings **28** for communicating the heated air toward the patient.

[0031] FIG. 5 illustrates schematically the closed loop in which the blanket **10** is deployed. A heat source **68** is provided for collecting ambient air, heating it, and directing it toward the patient through the second or lower sheet **24** of blanket **10**. The heated air is then communicated through the supply hose **64** to the blanket **10**. The heated air then travels through the blanket **10** as described above. Since at least a portion of the heated air is communicated out of the blanket **10** and toward the patient, the heat source **68** also serves to intake supplemental air to mix with the preheated air coming from the return hose **66** in order to supply the blanket **10** with sufficient pressure to force the heated air through the second sheet **24** and toward the patient.

[0032] Illustrated in phantom is a humidifier **70** for controlling the moisture in the air being directed toward the patient. In a conventional system, introducing moisture into the air stream is risky in view of airborne pathogens. However, in the present invention, an elevated humidity helps to increase the heat conductivity of the air. In order to prevent the moisture from being exhausted into the surroundings, both the first and second sheets **12,24** are fabricated from materials that serve as moisture barriers.

[0033] From the foregoing description, it will be recognized by those skilled in the art that a closed loop heat therapy blanket offering advantages over the prior art has been provided. Namely, as compared to conventional convection heating apparatuses in which all of the heated air generated by the heat source is evacuated from the thermal blanket, only that air necessary to heat the patient and the volume of air under the blanket is communicated from the blanket. The remaining heated air is communicated back to be mixed with supplemental air to be heated. Because a portion of the air is preheated, the heating requirements of the heat source are reduced. Further, because excess heated air is not being

introduced into the surroundings of the blanket, those working in the surroundings are not inconvenienced by heat.

[0034] While the present invention has been illustrated by description of several embodiments and while the illustrative embodiments have been

5 described in considerable detail, it is not the intention of the applicant to restrict or in any way limit the scope of the appended claims to such detail. Additional advantages and modifications will readily appear to those skilled in the art. The invention in its broader aspects is therefore not limited to the specific details, representative apparatus and methods, and illustrative
10 examples shown and described. Accordingly, departures may be made from such details without departing from the spirit or scope of the general inventive concept.